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Pilot Study: Knowledge and Attitudes Regarding Sport-Related Concussion in a Rural Interscholastic Sport Sample

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PILOT STUDY: KNOWLEDGE AND ATTITUDES REGARDING SPORT-RELATED CONCUSSION IN A RURAL INTERSCHOLASTIC SPORT SAMPLE

BY

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KNOWLEDGE AND ATTITUDES REGARDING SPORT-RELATED CONCUSSION IN A RURAL INTERSCHOLASTIC SPORT COHORT

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This thesis is approved as a creditable and independent investigation by a candidate for the Master of Science degree in Athletic Training and is acceptable for meeting the thesis requirements for this degree. Acceptance of this does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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I wish to dedicate this thesis to my late mother, Kimberly. She taught me to persevere and prepared me to face the challenges with faith and humility. She was a constant source of inspiration in my life. Although she is not here to give me strength and support, I always feel her presence, as it has encouraged me to strive to achieve my goals in life. This woman always believed in my ability to be successful in all avenues of life but put forth her greatest effort into making me successful in the academic arena. You are gone but your belief in me has made this long daunting journey possible, and for that I am forever grateful.

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ABSTRACT

PILOT STUDY: KNOWLEDGE AND ATTITUDES REGARDING SPORT-RELATED CONCUSSION IN A RURAL INTERSCHOLASTIC SPORT SAMPLE

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Context: Evidence supports education initiatives to improve knowledge of sport-related concussion (SRC) in active children and adolescents, as well as improve attitudes towards reporting concussion events to a supervising adult with the ultimate goal of early diagnosis and management. Most evidence focuses on urban and suburban children's SRC knowledge and attitudes; however, little is known regarding knowledge and attitudes of children participating in sport in rural environments. Understanding current knowledge and attitudes of rural children can inform future education and health behavior strategies that encourage early reporting. ***Objective:*** Two objectives guided this study. First, obtain and analyze pilot data regarding current sport-concussion knowledge and attitudes from a rural youth cohort using a validated survey tool for adolescents. Secondly, make recommendations regarding the use of the tool and process to apply this method to a larger sample. ***Design:*** Survey Design. ***Setting:*** Middle and high school education setting. ***Participants:*** Twenty of 81 students who participated in interscholastic sport at a rural high school completed the survey for a response rate of 24.7%. More females (70%) than males (30%) completed the survey (*M*age=15.0yrs, *SD*=1.89; range 13-18 years). ***Data Collection and Analysis:*** Rosenbaum Concussion Knowledge and Attitudes Survey – Student Version (RoCKAS-ST). ***Main Outcome Measure(s):*** Self-reported "likelihood to report", concussion knowledge index

(CKI), and concussion attitude index (CAI). ***Results:*** Concussion knowledge (CKI) was high amongst all respondents (19.7/25) and related positively to concussion attitude towards safe environments (CAI = 60.5/75). Students also self-reported a strong likelihood to report a concussion (7.3/10). Age, sex nor participation in contact verses noncontact sports did not vary from this trend with one exception; football respondents reported the lowest likelihood to report regardless of having knowledge and a safe attitudes. ***Conclusions:*** Although no formal education strategy has been delivered to this small cohort, respondents demonstrated a high or acceptable level of SRC knowledge, attitude and likelihood to report. The RoCKAS-ST as well at the process for delivering the survey was generally sound, however, delivering the survey during baseline testing may improve response rate. Future research should investigate the knowledge and attitudes of a larger cohort of rural student-athletes and should include more details on where students are receiving their education.

Key Words: Adolescent, concussion safety, interscholastic, injury reporting, knowledge, attitudes, education, athletic trainer.

INTRODUCTION

The topic of sport-related concussions (SRC's), particularly in youth, has become a major focus in sports medicine and the media over the past 20 years. Although media attention has been on the rise in the past decade, traumatic brain injury, particularly in children was recognized by the US congress as a public health issue as early as 1996.[1] The first educational campaign focused on raising awareness regarding sport-related concussion was the *Heads-Up: Concussion in High School Sports* toolkit launched in 2005.[2] This campaign was in response to epidemiologic data demonstrating the increasing numbers of sport and recreation related concussions occurring in children and youth every year. Initial data by the Center of Disease Control and Prevention (CDC) estimated 173,275 persons less than 19 years old were treated for nonfatal traumatic brain injuries (TBIs) related to sports and recreational activities between the years of 2001-2009.[3] In the United States alone there are over 300,000 concussions in high school sports.[4] More specifically, it is estimated that concussions occur at a rate of 3.1 per 100,000 athlete exposures in a high school population.[4] Using the RIO database to gather report rates throughout high schools across the United States, student-athletes are six times more likely to sustain a concussion during a game rather than practice.[5] Interestingly, even though numbers of recognized sport-related concussion are increasing, there is still evidence that not all children and adolescents report concussions.[6-9] If the condition is not reported, recognized and diagnosed immediately, and a child is allowed to return to participation before the brain has fully healed, their risk of suffering second impact syndrome (SIS), post-concussion syndrome (PCS), long term neurological deficits, and/or decreased quality of life also increases.[10-12] It would be unreasonable to believe that

we can prevent every incident of concussion, however, we can educate and encourage children to report their injury early, and therefore begin proper management and treatment, decreasing the risk of short and long-term impairments.[13,14]

If a child participates and suffers an injury to the head, the behavior we desire is for them report the adverse event to a supervising adult (i.e. coach, medical provider, or parent) in order to obtain a proper diagnosis and begin appropriate management. The Centers for Disease Control and Prevention is a strong proponent of incorporating education as the foundation for behavior change.[3] However, more recent literature suggests that education may only be one component to creating behavior change. Sawhney, et al. identified three factors which influence reporting (or non-reporting) of adverse events by parents and/or children to medical providers within healthcare systems: (1) length and quality of experience with the medical system; (2) ease of communication with providers and (3) self-confidence/knowledge in managing difficult situations.[15] Trust in providers, ability of providers to listen and work effectively as a team along with parents and children, having family support, and higher levels of self-literacy were all factors that positively influenced reporting. Generally speaking, research findings investigating the barriers and facilitators related to the likelihood of reporting acute sport-related concussion fall into similar categories: knowledge of the signs, symptoms and behaviors of concussion, athlete attitude towards safety related to concussion, team interaction that does or does not encourage reporting, coach's knowledge and attitudes and/or lack of access to qualified medical professionals at the time of injury.[16-19] Several landmark studies suggest that children who have higher levels of knowledge and are in an environment that embraces a safe attitude

towards reporting sport-related concussion are more likely to tell someone about their concern.

Starting in 2004, McCrea, et al. was first to establish an alarming rate of unreported SRC in youth football participants and established primary reasons why students chose not to report. Within this large sample, 15.3% (229/1532) of student-athletes reported sustaining a concussion, yet, in follow-up, it was determined that only half of those concussions were reported to a supervising adult. If they reported to an adult, that individual was usually an athletic trainer who was covering the event. The most common reasons for not reporting included the player did not feel as though the condition was serious enough to warrant further attention (perhaps not understanding adverse consequences), followed by other reasons such as not knowing the sign and symptoms (lack of knowledge) and wanting to continue participation (attitude). Findings from this study prompted a movement to provide focused education in order to improve attitude and likelihood to report.

Register-Mihalik, et al., almost ten years later, further investigated reporting trends among high school athletic participants, and also examined the effects of both concussion knowledge and attitudes regarding the likelihood student-athletes would report a concussion.[19] Within their sample, there were still a significant number of students who identified the lack of reporting concussive related events (either what they believed to be concussion or having their bell rung); however, the authors established that increased knowledge regarding concussion topics increased the likelihood that a student-athletes would report a concussion to a supervising adult. Students in this study also reported primary reasons for not reporting to be (1) not wanting to be removed from play and (2) not thinking

the injury was severe enough to report (both similar to McCrea, et al.[8]). In conclusion, education had an impact on attitude; however, investigating other factors affecting attitude, such as subjective norms or the environment for reporting may play a role in designing education programs that influence reporting behaviors.

Most recently, Taylor, et al. completed a systematic review of 4 studies focused on the relationship of concussion knowledge and the high school athlete's intention to report a concussion to a supervising adult.[17] As a primary construct, they grounded their investigation in the Theory of Reasoned Action (TRA), which encompasses two predictors of a person's intentions beyond knowledge of the condition: attitude toward the behavior and subjective norms.[17,18] Attitudes was further defined as how a youth feels about the knowledge they gained from an education session, in this case knowledge about concussion symptoms and consequences of not reporting. Subjective norms includes a person's perception of how he or she thinks significant others around them will view them if they report. Significant others in the case of sport-related concussion may include parents, teammates, coaches, healthcare providers, and the public. Key findings were consistent across the (4) studies supporting that education can influence attitude and student-athletes participating in environments embracing safe behaviors were more likely to report to a supervising adult. As an interesting note; however, these studies were all completed in an urban or suburban environment where children, parents, and school districts more than likely have access to medical professionals qualified to guide education, diagnosis, and treatment of sport-concussion. An emerging area for research is examining barriers and facilitators of SRC education, attitudes and subjective

norms for children who participate in rural environments. Determining a cause for unreported concussions is imperative to traumatic brain injury research and future preventative care.[12]

In the fall of 2011, a sport-concussion program was implemented across 7 rural school districts in Eastern South Dakota through South Dakota State University. The primary outcome of the project was to describe outcomes and severity of concussion in this rural population. Baseline (pre-injury) and post-injury neurological screenings were implemented to assist families with making informed management decisions related to their child's status if they were concussed. Since the inception of the project, over 4,000 children have completed baseline testing, and approximately 450 participants have completed post-concussion follow-up. Secondarily, the project assisted school districts with implementing sport-concussion policy including education, reporting, detection, and appropriate care for rural children participating in sport. This matched the introduction of South Dakota concussion state law.[20] However, education strategies have been minimal and attitudes and behaviors towards reporting have not been formally assessed among these school districts. Most schools offer no further education beyond the requirement that participants and their parents/guardians annually read and sign an informed consent document, which includes basic information on signs, symptoms and behaviors of sport-related concussion, guidelines for participant removal and referral to a qualified medical provider. We know students are reporting concussions related to sport participation; however, we don't know if this number represents some or all of the concussive events, whether current education is sufficient and whether or not we are creating the safest and most supportive environment for reporting concussions according to the substantiated health behavior theory.

Statement of the Problem

Currently, we do not have a clear understanding of the current knowledge and attitudes of rural children who participate in interscholastic sport in our cohort. Therefore, it is difficult to direct education and health behavior strategies, which will promote the health and safety of participants.

Objective

The primary objective of this study was to gain preliminary data regarding sport-related concussion knowledge and attitudes from a pilot group of rural youth who participated in sport. Secondarily, we wanted to examine the efficacy of the Rosenbaum Concussion Knowledge and Attitudes Survey – Student Version or RoCKAS-ST and make recommendations regarding the use of this tool and process to apply this method to a larger sample. Ultimately, findings from this study will help guide the need for planned education in rural environments and measure changes in attitude and culture of reporting among student-athletes.

Specific Aims: The following specific aims guided this study:

(1) What is the current knowledge and attitudes of a sample of rural interscholastic sport participants regarding sport-related concussions?

(2) Do boys and girls participating in rural interscholastic sport programs respond differently regarding their knowledge and attitudes about sport-related concussion?

(3) Do children in junior high school (7^{th} and 8^{th} grade) respond differently regarding their knowledge and attitudes about sport-related concussion than older children (9^{th} through 12^{th} grades)?

(4) Are student-athletes who have competed in contact sports more knowledgeable about concussions than those who have not completed in contact sports?

Significance of Study

This is the first study to specifically examine sport-concussion related knowledge and attitudes (KA) in a rural sample of students who participate in sport. Findings from this study will assist with determining if further assessment of KA should be examined in a larger sample of similar children (rural environments and whether or not planned education should be provided to student-athletes.

Definition of Terms: The following are defined for reader clarity:

Athletic Trainer (AT): A medical professional who specializes in the prevention, assessment, treatment, and rehabilitation of injuries to athletes and others who are engaged in everyday physical activity.[21]

Sport-related Concussion (SRC): "Sport related concussion is a traumatic brain injury induced by biomechanical forces. Several common features that may be utilized in clinically defining the nature of a concussive head injury include:

- SRC may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an impulsive force transmitted to the head.
- SRC typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously. However, in some cases, signs and symptoms evolve over a number of minutes to hours.

- SRC may result in neuropathological changes, but the acute clinical signs and symptoms largely reflect a functional disturbance rather than a structural injury and, as such, no abnormality is seen on standard structural neuroimaging studies.
- SRC results in a range of clinical signs and symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive features typically follows a sequential course. However, in some cases symptoms may be prolonged." [12]

Pediatric/Youth: Interchangeable terms used to describe a person under the age of 18 permitted to participate in interscholastic sport through the SDHSAA.[22]

Return to Play: The point at which an athlete who has sustained an injury is allowed to resume participation in sport-related activities.[23]

Concussion Knowledge: Accurate information, based on best available evidence, related to the condition itself as well as consequences of continuing to participate with the condition.[17]

Attitude Regarding Sport-Related Concussion: How a student-athlete feels about reporting a sport-related concussion after reflecting on their knowledge of the condition.[17]

Subjective Norms Regarding Sport-Related Concussion: How a student-athlete thinks significant others will view them if they report.[17]

BACKGROUND

Increased knowledge and awareness related to sport concussion plays a key role in encouraging student-athletes to report their condition, aiding clinicians in diagnosing a sport-related concussion, and assisting in the developing of an appropriate management plan to ensure students have the best potential to a full recovery. The objective of this study was to better understand the knowledge and attitudes regarding sport-related concussion of a pilot group of rural youth who participated in sport. The information gathered in this section supported the development of the introduction, methods and discussion sections, and assisted with supporting the overall need for the study. The background is divided into three tables:

Table 1: Epidemiology and Occurrence Rates of a Sport-Related Concussion

Table 2: Consequences of Under-Reporting SRC and the Differential Outcomes

Table 3: Effectiveness of Knowledge and Behavior in Terms of a Diagnostic Tool

Table 1: Epidemiology and Occurrence Rates of a Sport Concussion

Study	Objective	Study Type	Methods	Results	Findings
Castile et al. (2011)[4]	Compare epidemiology of new versus recurrent concussions sustained by high school athletes in recognition of symptoms and mechanism.	Cross Sectional	Collected data from nine sports over the course of five years using the RIO system as a database.	Over 730,000 concussions occurred in the five-year period and it equated to 3.1 concussions per 100,000 athlete exposures.	13.2% of the concussions that occurred were recurrent in nature. The study concluded that the symptom percentages matched with previous literature.
Rose et al. (2015)[24]	Define "concussion" and how it relates to adolescent athletes. Compare concussion to terms such as traumatic brain injury (TBI), and biomechanically induced altered brain function	Qualitative	Reviewed the literature across pediatric concussions and generalize a consensus.	Analyzed the concussion and diagnosis in adolescent athletes and non-athletes. Highlighted the potential for second impact syndrome and chronic traumatic encephalopathy.	Diagnosis for children differs from adults with the same symptoms and epidemiology.
Frommer et al. (2011)[25]	Compare gender differences in high school sport related concussions from a symptom and return to play aspect.	Descriptive	Collected data from one hundred high schools and use epidemiology reports to compare each school.	There were no obscure findings within the genders. However, the types of symptoms differed between each gender.	Return to play time and epidemiology had no significant differences. This makes sports related concussions the same between genders in a high school cohort.
Sallis et al. (2000)[26]	Assess the prevalence of headaches among high school football players and how it relates to a potential concussion. Uses knowledge of headache and other related symptoms to strengthen the case of a diagnosis.	Cross Sectional	Calculated the frequency of headaches associated directly with football.	Four fifths of the surveyed members reported having a headache related to a football hit. One fifth reported playing through a headache in a previous game	Risk of second impact syndrome is much higher than previously measured. The number of headaches in relation to concussions reported is a very poor correlation.
Marar et al. (2012)[5]	Develop conclusions related to athlete exposures and concussions in high school sports	Descriptive	Used the RIO database to measure athlete exposures for high school student athletes from 2008-2010.	Concluded that a concussion injury was six times more likely in competition versus practice or other activity.	Concussion incidence data is highly subjective to the method of collecting data along with location, definition of concussion, and sport differences.

Table 2: Consequences of Under Reporting SRC and the Differential Outcomes

Study	Objective	Study Type	Methods	Results	Findings
McCrea et al. (2004)[8]	Use national reporting data to analyze the number of unreported concussions in high school football players	Retrospective Survey	Distributed a survey to high school football players and gather how many concussions they endured during the season. Included in this survey was previous concussion history and if concussion was reported or not	29.9% reported having a history of a concussion; 15.3% reported having a concussion during the season; and of those, 43.7% reported the concussion	There is a clear majority of the concussions that went unreported. The main finding was the lack of education relating to seriousness of concussions
Williamson et al. (2005)[9]	Analyze different reporting varieties for concussions in youth hockey and compare them against each other	Cross-sectional	Researchers used official injury reports, direct observation, and retrospective player surveys. Analyzed AE and compared them against each strategy will yield the reporting differences between each method	Official injury reports listed .25 and .61 concussions per 1000 exposures; direct observation yielded between 4.44 and 7.94 per 1000; and player surveys listed between 6.65 and 8.32 per 1000 exposures	Most concussions failed to show up on the injury report and even with direct observation, but it presents a clear underreporting problem
Greenwald et al. (2012)[27]	Identify methods to increase diagnosis of athletes with head injuries. While incorporating prevalence and incidence data to determine number of concussions that may be missed	Descriptive	Created more stringent guidelines for return to play and implement the risk of a brain injury at all levels	N/A	N/A
Register-Mihalik et al. (2013)[19]	Examine knowledge of concussion and the reporting behaviors of high school athletes. Distinguishing knowledge from behavior in the survey questions was imperative	Cross-sectional	Conducted a cross sectional survey to capture data on concussion knowledge, attitude towards concussions, and potential recurrent concussions or previous concussions	A bridge between knowledge and reporting prevalence in concussions. Findings also showed that not reporting a concussion to a medical professional or coach correlated with negative behavior towards concussions	Main findings show the knowledge and behavior towards concussions drastically impacts the reporting numbers of concussions

Table 2: Consequences of Under Reporting SRC and the Differential Outcomes (cont.)

Study	Objective	Study Type	Methods	Results	Findings
Meier et al. (2014)[7]	Examined the patterns of symptoms reported in concussed athletes two different environments	Cohort	Self-reported symptoms were recorded through ImPACT system and then through interviews for anxiety and depression	There was a significant difference on concussion symptoms two days' post-concussion versus nine days after. Fewer symptoms were reported to athletic trainers using ImPACT than a confidential setting	Findings show that behavior can influence underreporting numbers. It also demonstrated the need for a return to play protocol that will meet all symptoms
Llewel-lyn et al. (2014)[28]	Examined the report and unreported rates of concussions in collegiate student athletes throughout their career	Retrospecti ve Survey	Used of a survey to determine the number of self-reported concussions, unreported concussions, and the potential of an unrecognized concussion	Self-reported concussion rate was 33.5%, unreported concussions were 11.8%, while the unrecognized concussion was at 26.1%	Main finding is the high number of unrecognized concussions combined with the fact that over 11% had at least 3 concussions in their career
Elliott et al. (2015)[29]	Examined the use of helmet-based head impact sensors combined with exposures to occur for possible error in concussion injury risk curves.	Cross-sectional	Provided a platform of statistical analysis to measure true concussion rates against sensor error and account for an injury curve	Data concluded a 95% credible rate of the sensors against actual concussions with over 300,000 exposures measured (57 total concussions reported)	Having three potential sources of error with concussion reporting in sensors there was only minor issues with using sensors as a possible diagnostic tool

Table 3: Effectiveness of Knowledge and Behavior in Terms of a Diagnostic Tool

Study	Objective	Study Type	Methods	Results	Findings
Rosen-baum et al. (2010)[16]	Develop a new measure of concussion knowledge and attitudes that is more comprehensive and psychometrically sound that previous tools	Survey validation	Recruited high school students ranging from grades 9-12. Administer the survey to 569 students to assess concussion knowledge and attitudes.	The survey was analyzed by three neuropsychologists, one pyschophysiologist, and one industrial psychologist. The results were compared with Marlowe-Crowne using product correlation analysis and determined the ROCKAS-ST to be a valid concussion knowledge and attitude survey tool.	The survey tool was assessed with test-retest reliability and put through rigorous tests from many different levels of experts to determine its validity.
Register-Mihalik et al. (2013)[19]	Understanding the influence knowledge and attitude have on self-reporting concussions in a high school athlete population	Cross-sectional study	A single survey was administered to high school athletes across six different sports. A test retest was done with the 50 students; with the test being taken the first time and a thirty-minute break and then retest in a different order	Only 16.9% of the student athletes reported symptoms of a concussion to a medical professional or a coach and less than half of them were removed from participation	Research shows a gap in education students have on concussions and reporting deficiency that is present. It also shows that athletes with a negative behavior towards concussions rarely reported having any symptoms to a medical professional or coach
Cournoyer et al. (2014)[30]	Determine the concussion knowledge of high school football players after initiation of a concussion education legislature	Cross-sectional study	Distributed a written questionnaire throughout 13 Florida high schools to determine the level of concussion knowledge. The questionnaire was created through a literature and expert review	25% reported never having any formal education of a concussion. 25% of adults, and 25%-50% of students were unable to name a symptom or more than one symptom of a concussion. Overall 25% of athletes reported playing with at least one symptom of a concussion	Some athletes were able to select the major concussion symptoms, but behavioral symptoms were hardly recognized. More education is needed to better help the student athletes fully understand a concussion and its implications

Table 3: Effectiveness of Knowledge and Behavior in Terms of a Diagnostic Tool (cont.)

Study	Objective	Study Type	Methods	Results	Findings
Meier et al. (2015)[7]	Examine the patterns of self-reported symptoms and the relation they expose to underreporting of concussions. This study attempts to standardize concussion diagnosis and minimize clinical reliance of diagnostic software.	Cohort study	Concussion symptoms were collected through the ImPACT system and compared to symptoms that were collected through private interview in a confidential setting	The athletes reported far less symptoms on the computer software versus face to face with an athletic trainer in the confidential setting	The questions asked on the computer diagnostic systems fails to gain a personal connection or establish a sense of security which is dependent on self-reporting. This may lead to further underreporting if a potentially concussed athlete is just given a computer-based examination
Sawhney et al (2016)[15]	Analyzed the barriers and facilitators present in reporting adverse events through desired family characteristics and the outcomes associated with them	Qualitative	Six focus groups were formed with three being parents and three being adolescents. The field notes, team debriefings, and audio recordings were analyzed through qualitative analysis software NVivo	Showed three main factors limiting reporting of adverse events. Experience with the health care system, degree of personal confidence, and type of communication with health care providers all limited the potential to report	Experience, communication, and confidence pose three factors that block proper reporting of events. This information can apply to concussions and other sporting event related injuries

METHODOLGY

Arrangements for Conducting the Study

The principal investigator implemented the following steps to ensure the credibility, reliability and validity of the study.

Ethical Approval

The principal investigator sought and obtained approval from the Institutional Review Board at South Dakota State University. Written parent/guardian permission and student assent was obtained prior to a child's inclusion in the study. A copy of the IRB approval is in Appendix A. A copy of the permission and student assent is available in Appendix B.

Participant Selection

Arrangements were made with school administration to distribute the surveys to approximately 80 middle/high school students from one rural school district. Both boys and girls in grades 7-12 were invited to participate. Interscholastic sports offered at this school include football, girls' volleyball, sideline cheer, boys and girl's cross-country, boys' and girls' basketball and boys and girls track and field. These students participated in at least one interscholastic sport during the current school year.

Outcome Measure

Demographics and Rosenbaum Concussion Knowledge and Attitudes Survey – Student Version (RoCKAS-ST)

The survey delivered included two sections: demographics and the RoCKAS-AT. The principal investigator developed a 9-question demographic section to include at the beginning of the survey to collect characteristic information pertaining to the respondents.

The primary outcome measure used to collect responses related to both concussion knowledge and attitudes towards safe participation and concussion was the Rosenbaum Concussion Knowledge and Attitudes Survey – Student Version (RoCKAS-ST). This tool has been established as a reliable and valid measure in a high school population.[16] This instrument was identified through a comprehensive search of available databases including PubMed, SPORTdiscus, and MEDline. A copy of the survey is included in Appendix C.

The RoCKAS-ST consists of 55 items divided into 5 sections. For scoring and interpretation purposes, the sections are further divided into two index constructs: The Concussion Knowledge Index (CKI) and the Concussion Attitude Index (CAI). Scoring instructions were discussed in Rosenbaum et al.[16] The CKI was derived from responses to 25 questions (after removing distractors) across Sections 1, 2 and 5. Each correct response was awarded 1 point and an incorrect response was awarded no points; therefore, possible scores for the CKI ranged from 0-25. Higher scores suggest greater knowledge regarding sport-related concussion. The CAI score was derived from Sections 3 and 4. Responses to the attitude-based questions were measured on a 5-point Likert scale (with 1=strongly disagree to 5=strongly agree). Participants received 1-5 points depending on the safety level of the response (1=very unsafe response, 5=very safe response). The range of scores on the CAI ranged from 15-75, with 15 indicating very unsafe attitudes and 75 indicating very safe attitudes.

Procedure

Following approval from Human Subjects, the primary investigator delivered the surveys to a local school district. The school administrator met with student-athletes at a predetermined time. At this time, the school administrator provided information on the study

including the objective of the study and specifics on the survey. Students were then invited to participate. Students were allowed to take the survey home and were encouraged to read through the instructions with their parents/guardian to determine if they would like to participate. If the child and their parents/guardian chose to participate, both signed the permission/assent form and the student completed the survey. Completed surveys were then delivered to the main office where an administrative assistant agreed to collect the surveys, separate the permission assent form from the surveys and organize the materials for transfer back to the principal investigator. Students were allowed approximately 3 weeks to complete the survey. The school administrator offered reminders to the students each week after the survey was distributed. After the data collection period ended, surveys were delivered to the principal investigator for data entry and analysis.

Data Analysis Procedures

Data was entered into an excel spreadsheet and prepared for analysis. Descriptive statistics were compiled to describe the general characteristics and demographics of participants, knowledge (CKI), attitudes (CAI) and likelihood to report. First, in order to assess knowledge and attitudes of participants, reporting frequencies for each of the 55 questions were compiled and organized into a table. Secondly, Rosenbaum, et al. included recommendations on compiling a concussion knowledge index (CKI) and a concussion attitude index (CAI) of the RoCKAS-AT.[16] Both indices were calculated based on the process used by Rosenbaum et al. in order to examine collectively student knowledge and attitudes.[16] A copy of the scoring sheet used to score the RoCKAS-ST survey is included in Appendix D.

RESULTS

Description of Participants (Demographics Section)

Eighty-one student-athletes from a local rural school district were invited to participate in the study and received the survey packet. Twenty surveys were returned for a 24.7% response rate. Responses to the survey's first eight questions offer a description of the student-athletes who participated (Table 4). Overall, student-athletes in grades 7-12 responded, with more females (70%) than males (30%) completing the survey (*M* age = 15.0 years; *SD* = 1.89; range 13-18 years). A majority of the respondents participated in basketball (35.5%) and track and field (20%). Four of the 20 student-athletes reported a previous concussion diagnosis. In total, 15/20 (75%) stated participating in concussion education within the last 12 months with the primary source of education delivered by a medical provider (35.5%). The final question in the demographics section asked students, in general, the likelihood they would report a concussion. Their response was based on a Likert scale from 1-10, with 1 related to least likely to report and 10 related to very likely to report. The sample mean was 7.3/10.

Table 4: Participant Demographics and Characteristics

Characteristic	Sample
Age, mean (SD), yrs.	15.0 (1.89)
Education, mean (SD)	9.25 (1.77)
Gender, No. (%)	Male = 6 (30%); Female = 14 (70%)
Sport Participation, No. (%) (Check all that apply)	Basketball = 16 (35.5) Competitive Cheer = 0 (0) Competitive Dance = 0 (0) Cross Country = 2 (4.4) Football = 5 (11.1) Golf = 8 (17.78) Gymnastics = 0 (0) Sideline Cheer = 7 (15.5) Soccer = 0 (0) Tennis = 0 (0) Track and Field = 9 (20) Wrestling = 0 (0)
Diagnosed w/Concussion, No. (%)	Yes = 4 (20), No = 16 (80), Unsure 0 (0)
Received Concussion Education, No. (%)	Yes = 15 (75), No = 2 (10), Unsure = 3 (15)
Mode of Concussion Education, No. (%) (Check all that apply)	Medical Provider = 9 (37.5) Coach = 5 (20.83) Consent Form from SDHSAA = 3 (12.5) Web Source = 2 (8.33) Fact Sheet = 2 (8.33) Parents = 1 (4.17) Magazine/Print = 1 (4.17) Other = 1 (4.17)

Cohort Responses Related to Knowledge and Attitudes of SRC

As a general reference, student responses to items related to the concussion knowledge index (CKI) are reported in Table 5. The CKI table is presented as a percentage correct of the 20 total survey takers. There are three questions in this table that are validity questions with no index related to them: “Weightlifting helps to tone and/or build muscle.”,

"High-school freshmen and college freshmen tend to be the same age.", and "Cleats help athlete's feet grip the playing surface." These questions were not factored into the CKI of the cohort but are shown for comparison.

Table 5: Participant Responses for Concussion Knowledge Questions (CKI)

Item	* % Correct
In order to be diagnosed with a concussion, you have to be knocked out.	100
Weightlifting helps to tone and/or build muscle.	100
If you receive one concussion and you have never had a concussion before, you will become less intelligent.	100
High-school freshmen and college freshmen tend to be the same age.	100
Concussions can sometimes lead to emotional disruptions.	100
Even though player F is still experiencing the effects of the concussion, his performance will be the same as it would had he not suffered a concussion.	100
Cleats help athlete's feet grip the playing surface.	95
Symptoms of a concussion can last several weeks.	95
There is a possible risk of death if a second concussion occurs before the first one has healed.	90
An athlete who gets knocked out after getting a concussion is experiencing a coma.	90
It is likely that player X's concussion will affect his long term-health and well-being.	90
There is rarely a risk to long-term health and well-being from multiple concussions.	80
People who had one concussions are more likely to have another concussion.	75
If you receive one concussion and you have never had a concussion before, you will become less intelligent.	70
Being knocked unconscious always causes permanent damage to the brain.	70
Sometimes a second concussion can help a person remember thing that were forgotten after the first.	70
It is likely that player Q's concussion will affect his long-term health and well-being.	70
A concussion can only occur if there is a direct hit to the head.	60
After a concussion, people can forget who they are and not recognize others but be perfect in every other way.	60
After 10 days, symptoms of a concussion are usually completely gone.	25
After a concussion occurs, brain imaging (CAT scan, MRI, X-ray etc.) typically shows visible physical damage (bruise, blood clot) to the brain.	20

* Percentage of questions correct out of 20

Student responses to items related to the concussion attitude index are reported in Table 6. The CAI responses are reported as percentage of students responding either favorable levels of concussion attitude (SA/A), neutral (N), or less favorable levels of concussion attitudes (D/SD). The (SA/A) were grouped together therefore some questions

that may have had all 100% agree could have had more “4” on a Likert Scale compared to other questions that could have had a majority of “5”.

Table 6: Participant Responses for Concussion Knowledge Questions (CAI)

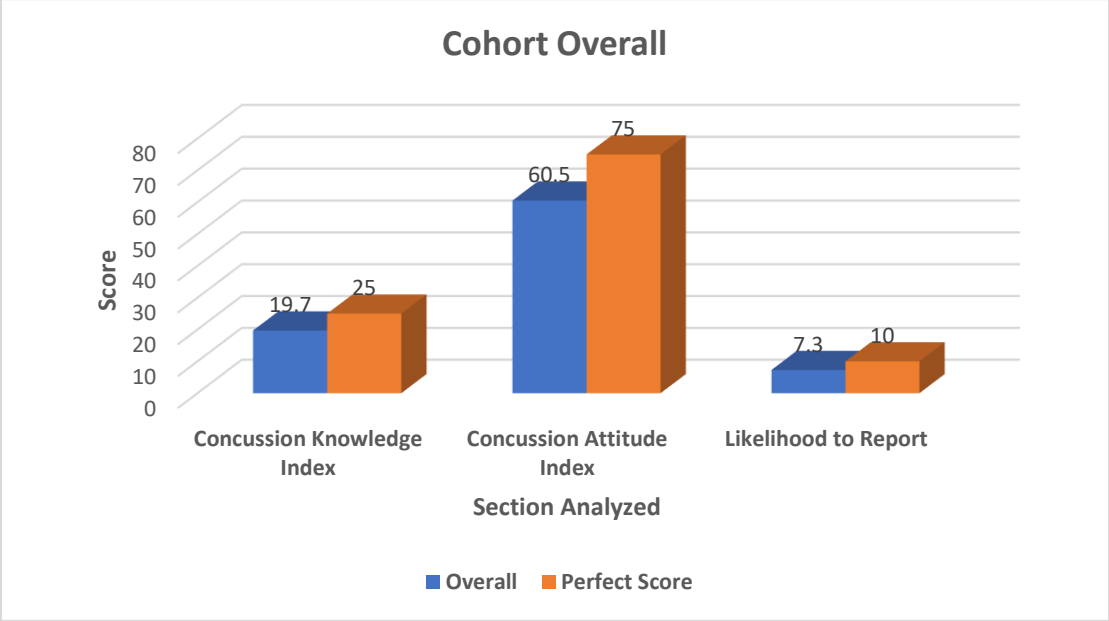
Item	*(%) SA/A	*(%) N	*(%) SD/D
I feel that Coach A made the right decision to keep Player R out of the game.	95	5	0
I feel that Athlete H should tell coach about the symptoms.	100	0	0
I feel that Athlete M should have returned to play during the first game of the season.	0	5	95
I feel that coaches need to be extremely cautious when determining whether an athlete should return to play.	75	20	5
I feel that an athlete has a responsibility to return to a game even if it means playing while still experiencing symptoms of a concussion.	5	15	80
I feel that the Athletic Trainer rather than Athlete R should make the decision about Athlete R returning to play.	80	15	5
I feel that concussions are less important that other injuries.	5	20	75
I feel that Athlete O should have returned to play during the semifinal playoff game.	10	15	75
Most athletes would feel that the Athletic Trainer rather than Athlete R should make the decision about returning Athlete R to play.	65	30	5
I feel that an athlete who is “knocked unconscious” should be taken to the emergency room.	70	20	10
I would continue playing a sport while also having a headache that results from a concussion.	15	20	65
Most athletes would feel that Athlete M should have returned to play during the first game of the season.	5	30	65
Most athletes would feel that Athlete H should tell coach about the symptoms.	55	35	10
Most athletes would feel that Coach A made the right decision to keep Player R out of the game.	50	30	20
Most athletes feel that Athlete O should have returned to play during the semifinal playoff game.	25	35	40
I feel that mouth guards protect teeth from being damaged or knocked out.	85	5	10
I feel that professional athletes are more skilled at their sport than high school athletes.	80	5	15
I feel that most high-school athletes will play professional sports in the future.	10	15	75

*SA=Strongly Agree; A=Agree; N=Neutral; D=Disagree; SD=Strongly Disagree

Figure 1 depicts comparative findings of the concussion knowledge index (CKI), concussion attitude index (CAI), and response on the question for the likelihood to report for all respondents. The CKI mean was 19.7/25, with a high of 24 and a low of 16. This score

suggests student-athletes reported a high level of knowledge for a majority of the questions. However, two questions of note were answered poorly by the sample: (1) only 20% of respondents answered the question "*After a concussion occurs, brain imaging (CAT scan, MRI, X-ray etc.) typically shows visible physical damage (bruise, blood clot) to the brain*" correctly and, (2) only 25% of respondents answered the question *"After 10 days, symptoms of a concussion are usually completely gone*" correctly (Table 5). The mean of the CAI was 60.5/75 with a low of 49 and a high of 73. A mean of 60.5 suggests students' responses trended between neutral (45) and very safe (75) in their attitudes towards concussion and safe participation. The final data point measured from the sample of student-athletes was the likelihood to report concussion symptoms. The mean of students' responses was 7.3/10, again, trending towards a strong likelihood of self-reporting a concussion. The mean from the CKI suggests this sample of students has reasonable knowledge of concussion. The mean from the CAI suggests this sample has a strong attitude towards safety. These indices also relate to a high likelihood of reporting a concussion should a child sustain head injury. A positive trend exists between knowledge, attitude and likelihood to report.

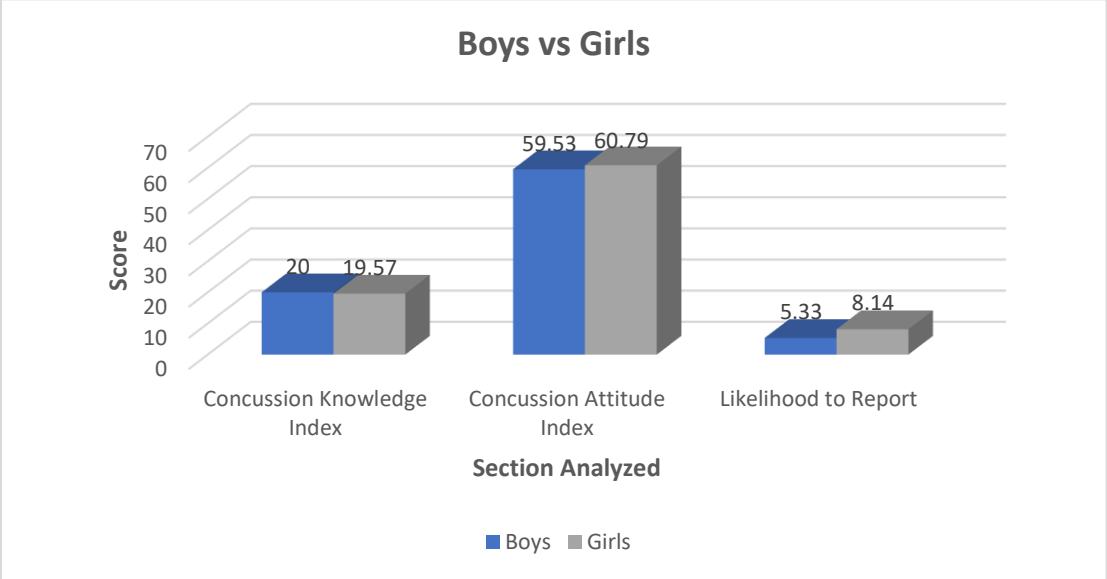
Figure 1: Cohort Responses Related to Concussion Knowledge, Attitudes and Likelihood of Reporting.



Gender Influence on Knowledge and Attitudes of Sport-Related Concussion

A comparison between responses of 6 boys and 14 girls towards knowledge, attitudes and the likelihood of reporting concussions is illustrated in Figure 2. Boys responded to the CKI questions with a mean of 20.0 (range 19-22), whereas girls responded with a mean of 19.6 (range 16-24). Very little difference exists between the responses of the two genders on the CKI. The CAI for the boys had a mean of 59.8 (range 49-73), while the girls had a mean of 60.8 (range 51-71). Once again, both genders were close in attitude towards safety and concussions. In addition to these two indices, girls self-reported that they were more likely to report concussion (*M*=8.14) than boys (*M*=5.33). Of note, the boys' group responses may have been most influenced by the small subset of football athletes (male) who reported a mean of 4.4 out of 10 on their likelihood to report.

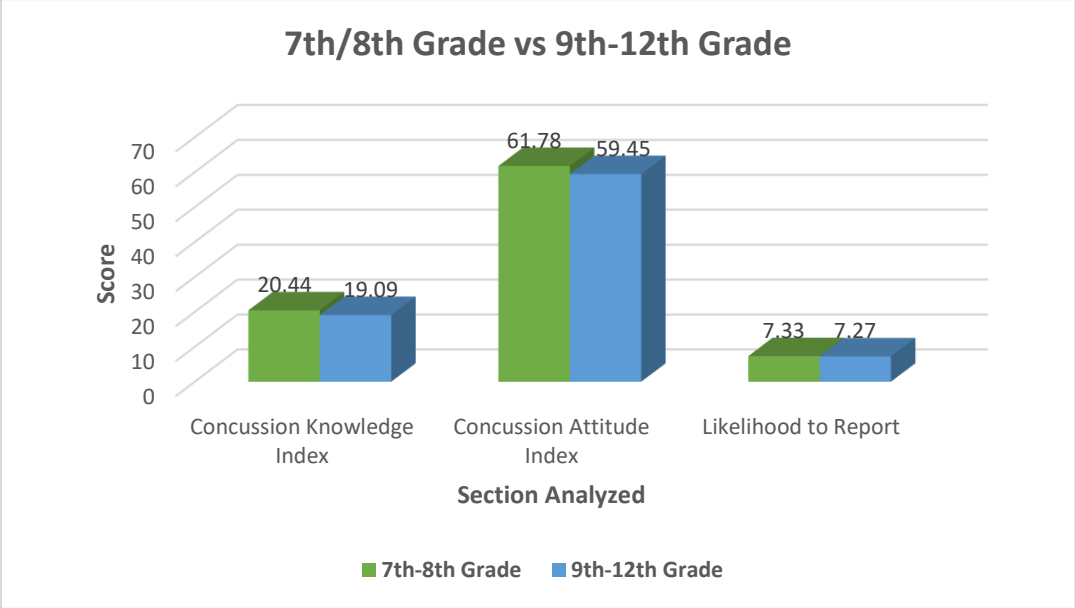
Figure 2: Boys and Girls Responses Related to Concussion Knowledge, Attitudes and Likelihood of Reporting.



Age Influence on Knowledge and Attitudes of Sport Related Concussion

Responses from younger students (grades 7 and 8) related to concussion knowledge, attitude and likelihood to report were compared to responses from older students (grades 9-12). An overview of their responses is illustrated in Figure 3. The younger student-athletes reported a mean CKI of 20.44 (range=17-24) and a mean CAI of 61.78 (range=51-73). The older students reported a CKI mean of 19.09 (range=16-21) and a mean CAI of 59.45 (range=49-71). The CKI and CAI means for the younger students represented the highest values of all groups compared. Both groups were similar in their self-reported likelihood to report a concussion.

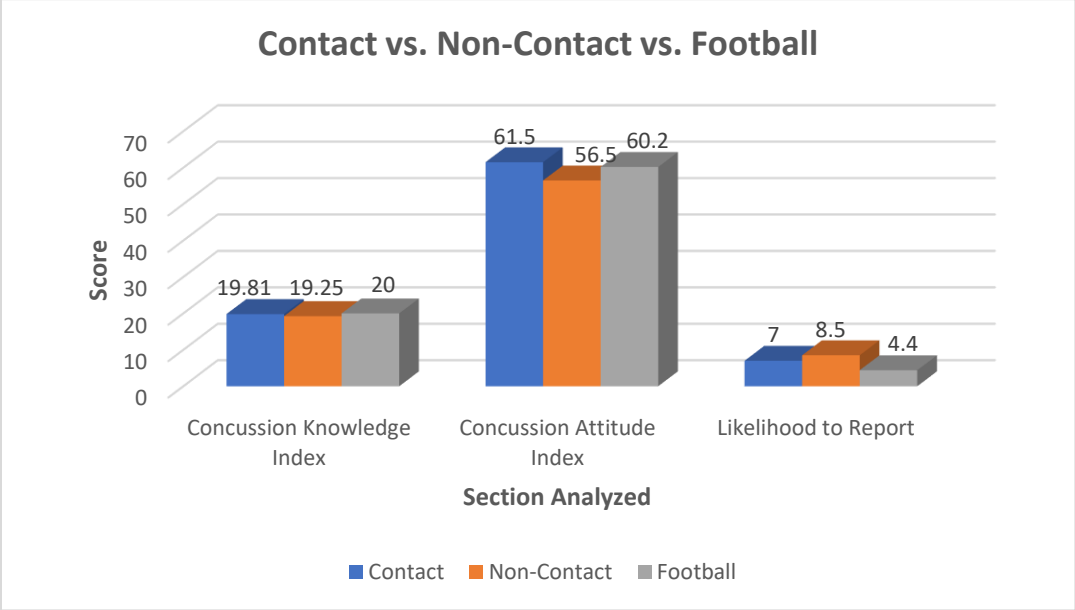
Figure 3: Younger Students (7/8graders) vs Older Students (9-12thgraders) Responses Related to Concussion Knowledge, Attitudes and Likelihood of Reporting.



Influence of Participation in Contact Sport vs Non-Contact Sport on Knowledge and Attitudes of Sport Related Concussion

The final analysis for comparison between groups included an examination of responses from students who reported participating in contact sports versus students who participated in non-contact sports. Contact sports included basketball, football, soccer, gymnastics, and wrestling, while non-contact sports included competitive cheer, competitive dance, cross-country, golf, sideline cheer, tennis, and track and field. Additionally, students who reported participating in football were analyzed separately to see if students participating in football responded differently than students in other contact sports (i.e. basketball). The mean of responses for the knowledge and attitudes indices were very similar for each group, with a positive trend, once again between education and safe attitude regarding concussion. Figure 4 illustrates the relationship between CKI, CAI and self-reported likelihood to report.

Figure 4: Contact Sport Participant Responses vs Non-Contact Sport Participant Responses Related to Concussion Knowledge, Attitudes and Likelihood of Reporting



DISCUSSION

The primary purpose of this study was to gain preliminary data regarding sport-related concussion (SRC) knowledge and attitudes from a pilot sample of rural student-athletes in an effort to inform the need for more focused and/or formal education strategies for rural children. Students in the selected school district for the study have participated in a sport-concussion testing program since Fall of 2011 (SRC Project). The focus of this program is on incorporating evidence-based assessment strategies (baseline through post-concussion testing) to detect sport-related concussion; however, this program did not include a formal education process in regard to the signs, symptoms and behaviors of SRC as well as directly trying to influence attitudes towards safe behaviors and increasing the likelihood of reporting. At best, students and their parents signed the required consent forms related to SRC each year; however, no other strategies were explored. Over the 7 years of SRC project, students have reported concussions; however, this number may not represent all concussions that could have been reported. We know little about the current knowledge, attitudes and likelihood to report concussions in this cohort.

Overall, the sample demonstrated an acceptable level of knowledge regarding basic signs and symptoms of concussion, which is the first step in recognizing, reporting and seeking care following an injury. This group of students also demonstrated positive attitudes towards creating a safe environment for reporting concussion, namely properly identifying situations where a student-athlete should be removed from play due to potential consequences of a concussion and personal safety regardless of context. In addition to knowledge and attitudes, this group, as a whole, would likely report a concussive event to a supervising adult. Concussion knowledge and attitudes play a critical role in successful

concussion reporting in sport.[17-19] Specifically, literature suggests that students who are more knowledgeable about SRC have safer attitudes towards reporting and are more likely to report a concussion. Findings from our sample of rural students are consistent with findings from literature.

Descriptive comparisons between sex, age and student participation in contact vs noncontact sports showed similar trends as the entire cohort between knowledge, attitude and likelihood of reporting. There were two exceptions or points to note in regards to the overall trend. First, boys demonstrated acceptable levels of knowledge and positive attitudes towards a safe environment; however, were less likely to report a concussion when compared to girls. Secondly, those participating in contact sport, particularly football (all boys) were less likely to report – regardless of their acceptable level of knowledge and attitudes. This finding is consistent with other studies that focused on reporting behaviors in high school football athletes.[8,30] We did not specifically ask respondents to further explain what affected their likelihood to report; however, perhaps the reasoning behind this finding relates to the culture of football. Football carries the greatest risk for SRC (and most other injuries) of all the sports reported in this study; and participants tend to accept this level of risk and play with injury in order to continue to participate. McCrea reported that the most common reasons for football players to not report a concussion included not thinking the injury was serious enough and not wanting to come out of the game.[8] In order to improve reporting within our cohort, these two concepts should be considered.

Research studies suggests that athletes who have received education were twice more likely to report their symptoms to a medical provider.[17] Respondents in this study appear to be well informed in regards to the signs, symptoms and behaviors of sport-related concussion

and have positive attitudes towards creating a safe environment for reporting concussions; however, these students have never participated in a formal education effort. Regardless of not participating in formal education, these students have been exposed to information regarding to SRC in a variety of ways. First is by reading print material each year as a requirement of the South Dakota High School Activity Association and local school districts.[20] Secondly, and most commonly reported by students in this study, has been information shared by a medical provider. Unlike most rural school children who participate in sport, this cohort did have access to an athletic trainer who delivered baseline neurologic screenings prior to the start of participation, at their school part-time and if a concussion occurred, was available to complete post-concussion testing. Perhaps, indirectly, students learned both more about the signs, symptoms and behaviors of SRC as well as the decision-making process should a concussion occur. Options for more formal education[31,32] are available and/or developing a feasible program is a possibility. Ultimately, data from a larger sample would help in guiding the decision to put time and resources into developing an education program.

The sample size for this study was small which we knew from the outset. Therefore, a secondary purpose of this study was to determine if the selected process for survey delivery, and the use of the RoCKAS-ST would be appropriate for delivery to a larger sample of students and therefore gather data that would be more representative of rural student-athletes. In general, the Rosenbaum Concussion Knowledge and Attitudes Survey – Student Version (RoCKAS-AT) is a validated survey for an adolescent athlete population with the ability to calculate both a concussion knowledge index and a concussion attitude index.[16] Although the survey is a little long, respondents seemed to answer questions reliably and in a

reasonable amount of time (i.e. 15 minutes). The recommendation at this time would be to retain the survey. The process of delivery should be changed however, to encourage more students to respond. For this study, forms to obtain parent permission and student assent along with the surveys were sent home with the students, and our response rate was fairly low. The recommendation to improve the response rate would be to include the survey along with the baseline neurological testing process prior to participation.

Clinical Implications

More data should be collected in order to establish a baseline of knowledge, attitudes and likelihood to report SRC by rural children participating in sport; however, if a formal education process were to be implemented, the findings from this study, in conjunction with current literature offer the following suggestions:

(1) Ensure students are getting the correct information from parents, coaches, officials, teammates, and medical providers. Incorporating ideas from a qualified medical team to meet the needs of each school district can help ensure the accuracy of the message. Reviewing currently available tools and/or creating a new design would both be feasible.

(2) Education should include, at minimum, common mechanisms, as well as a description of signs, symptoms and behaviors associated with sport-concussion.

(3) Beyond understanding the signs, symptoms and behaviors, education should also discuss the decision-making process that goes into removing a player from participation if there is a potential concussion. If student-athletes understand that the post-concussion assessment and management process is meant to individualize the approach, and that not all participants are withheld following an appropriate

assessment, they may be more likely to report the injury and ensure the fastest recovery for themselves as an individual. As with other injuries, there is a timeline with rehabilitation and intervention options.

(4) Education should include current research supporting the benefits of early removal following a concussive event. Student-athletes at the high school and collegiate level who report a concussion when it occurs and stop participation rather than continue to play are likely to return on average 5 days sooner.[13,33] Although student-athletes may not want to come out of a practice or game, if they come out, they could potentially be ready to come back into participation sooner.

(5) Student-athletes should be informed of potential treatment options that will be discussed following a sport-related concussion. Previously, complete or strict rest until all symptoms were resolved (perhaps 10-14 days) was the primary course of treatment. However, qualified medical providers now use an individualized assessment and treatment approach that considers programmed physical activity, oculomotor exercises and vestibular therapy after a brief period of protective rest (24-72 hours) through the management process, which keeps the participant more active and involved in their care.[12,34]

(6) Education should express that sport-related concussions are a serious health concern but with the proper reporting and medical care they can be handled in an appropriate timeframe allowing the athlete to return to play without risking long-term complications.

Limitations of the Study

As a pilot project, this study had several limitations. First, as with all survey research, the responses are based on an individual's ability to understand the questions and the data is self-reported. We did select a survey tool with strong reliability and validity (RoCKAS-ST) and was designed for adolescent athletes; however, it is difficult to infer why students responded the way that they did; we can only report how they responded. Secondly, this study was limited in sample size and created a challenge of being able to get a majority of the sports and age groups represented to fully distinguish differences or trends in the results. Ideally, administering this survey in conjunction with baseline neurological screening across multiple school districts would increase response rates. We were only able to report descriptive data from these responses. Being able to maximize the number of students reached with this study will allow the researcher to determine if there is significant difference in the concussion knowledge index (CKI) and the concussion attitude Index (CAI) of the RoCKAS-ST.

Recommendations for Further Research

The following recommendations are offered for further research based on the results of the current study:

(1) Repeat the basic design of this study but include a larger sample size from more rural school districts who participate in a larger cross-section of sport. Findings from a larger sample of students participating in sport in a rural environment can add to current research, which has focused on suburban and urban adolescent sport participants.

(2) Include schools that have access to an athletic trainer full time, limited access to an athletic trainer and schools that do not have access to an athletic trainer or other medical provider at their school.

(3) If it is determined that a formal education approach is delivered, retest students at some point after the intervention to determine if their education experience contributed to changes in knowledge and attitudes of concussion.

(4) This study focused on student's knowledge and attitudes; however, subjective norms and the environment for reporting can affect whether a child reports a concussion or not. The authors of the RoCKAS-ST also validated surveys for coaches and parent's knowledge and attitude. Completing complementary studies of coaches and parent's knowledge and attitude better help us understand the full culture of sport towards safety and sport-related concussions.

CONCLUSION

This study was completed to assess the knowledge and attitudes of student athletes in a rural youth cohort towards sport-related concussion. The sample demonstrated an acceptable level of knowledge regarding basic signs and symptoms of concussion, which is the first step in recognizing, reporting and seeking care following an injury. This group of students also demonstrated positive attitudes towards creating a safe environment for reporting concussion, namely properly identifying situations where a student-athlete should be removed due to potential consequences of a concussion and personal safety. In addition to knowledge and attitudes, this group as a whole, would likely report a concussive event to a supervising adult.

The age groups assessed in this research create unique opportunities for future research. Whereas as student-athletes in McCrea's study were at the beginning of the movement to change the culture around safety and sport concussion (2004), students in 2018 have not known an environment where sport-related concussions and potential consequences have not been openly discussed. The findings in this study showed the 7th and 8th graders had a slightly higher likelihood to report and showed overall higher scores on the CKI and CAI. The implications of this may be related to exposure to the risk of SRC as a result of media campaigns and attempts to create a safer environment.

In summary the knowledge and attitudes regarding sport-related concussion in a rural interscholastic sport sample have shown to be positive in nature thus allowing us to use the pilot data to shape future research in rural environments. South Dakota demographics are mostly rural and lack typical access to medical providers that is common in urban areas. However, we can use a combined approach of the student athletes, coaches, medical

providers, officials, and parents to increase reporting numbers throughout the state. Implementing further research on different rural cohorts will allow more in-depth conclusions about concussion reporting in rural settings.

Appendix A

Office of Research Assurance and
Sponsored Programs

Box 2201, SAD 200
SDSU
Brookings, SD 57007-1998
Phone: 605-688-6696
FAX: 605-688-5530

Dianne.Nagy@sdstate.edu

To: Austin Westland, Department of Health and Nutritional Sciences Date:

February 7, 2018

Project Title: Knowledge and Attitudes About Sport-Related Concussion in a Rural Interscholastic Sport Cohort

Approval #: IRB-1802003-EXP

SDSU's Human Subjects Committee approved your project using expedited procedures as described in 45 CFR 46.110. The research activity was deemed to be no greater than minimal risk, and the following expedited category from 63 FR 60364-60367 was found applicable:

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

One-year approval of your project will be dated starting 2/7/18. If you require additional time to complete your project, please submit a request for extension before 2/6/19. If there are any unanticipated problems involving risks to subjects or others, or changes in the procedures during the study, contact the SDSU Research Compliance Coordinator. Protocol changes must be approved by the Committee prior to implementation. Forms may be found on the Human Subjects web page. Please inform the committee when your project is complete.

If I can be of any assistance, don't hesitate to let me know.

Sincerely,

Dianne Nagy
Acting IRB Coordinator

Appendix B

February 5, 2018

Dear Parent/Guardian and Student,

Hello, my name is Austin Westland and I am a graduate student in athletic training at South Dakota State University. As a future athletic trainer, I am very interested in creating safe and healthy sport environments for young rural student-athletes like you, particularly those at risk for suffering sport-related concussion. In order to set up a safe playing environment, I am conducting a survey for a project entitled *"Knowledge and Attitudes of Sport-Related Concussion in Rural Youth"* to better understand what students currently know regarding sport concussion. I will use the findings to recommend future education and prevention plans for active rural children.

You, as a student who participates in sport, recreational and other activities in a rural community, are invited to participate in the study by completing the attached survey. I am also requesting permission from your parent/guardian to allow you to participate. In order to help you decide if completion of the survey is appropriate, I am sending this letter and survey home with you to consider participation.

We realize your time is valuable and have attempted to keep the requested information as brief and concise as possible. Completion of the survey will take approximately 10-15 minutes of your time. Your participation is voluntary, and there are no known risks to participation. If you choose to participate, please provide signatures on the next page, and simply complete the survey. You can hand it back into your school's administrator no later than February 15, 2018. If you do not wish to participate, you may simply discard the survey. Please keep this letter this letter for your information and/or if you would like to contact the researcher at any time.

Please note that although we ask some descriptive questions about you, there is no individual identifying information on the survey (i.e. names, etc.). The permission page will be separated from the survey by your school's administrator before they are handed in to me – so I will have no way of knowing how you response to the questions. Your responses are strictly confidential. When the data are presented, you will not be linked to the data by your name, title or any other identifying item. All results will be reported as group data.

If you have any questions, now or later, you may contact me, or my advisor (Dr. Bernadette Olson) at the numbers below. Thank you very much for your consideration, time and assistance. If you have any questions regarding your rights as a research participant in this study, you may contact the SDSU Research Compliance Coordinator at 605-688-6975 or SDSU.IRB@sdstate.edu. We hope you will choose to participate (and/or allow your child to participate). (This project has been approved by the SDSU Institutional Review board, Approval No.:)

Sincerely,

Austin Westland
Primary Researcher/SDSU

Bernadette L. Olson, EdD, AT, ATC
Project Advisor/SDSU

Parent/Guardian Permission AND Child Assent From
"Knowledge and Attitudes of Sport-Related Concussion in Rural Youth"
South Dakota State University
Brookings, South Dakota 57006

PLEASE RETURN WITH SURVEY TO YOUR SCHOOL ADMINISTRATOR

This project has been approved by the SDSU Institutional Review Board: IRB -

We, (parent/guardian and child) have read and discussed the letter and information sheet describing the study entitled *"Knowledge and Attitudes of Sport-Related Concussion in Rural Youth"*. By checking yes and signing this form, as parent/guardian, I am giving permission to allow my child to participate and, as the child, I am agreeing to participate. Below, there is a box for both the parent and the child to check. We have not included a "no" option – if you choose not to participate, simply don't return the completed survey. **Only students who agree to participate as well as their parents providing permission will be included in the study.** This form will be separated from the survey before the survey is delivered to the researcher and permission forms will be maintained in a locked filing cabinet, yet available for review at any time by the members of the Human Subjects Committee at South Dakota State University.

For **CHILD** (participant) to complete:

Name of child (please print):	
☐ Yes, I would like to participate in the study.	
Signature of child:	Date:

For **PARENT/GUARDIAN** to complete:

Name (please print):	
☐ Yes, I would like my child to participate in the study.	
Signature:	Date:

Appendix C

ROCKAS-ST Concussion Survey

ABOUT YOU - Directions: In this section, we are trying to understand your background. Please read each question and answer as honestly and accurately as possible. If you prefer to not answer a question, please leave your response blank.

1	What is your age?	
2	What grade are you in?	
3	Sex	___ Male ___ Female
4	What sport(s) have you participated in within the last 12 months at your school?	___ Basketball ___ Competitive Cheer ___ Competitive Dance ___ Cross Country ___ Football ___ Golf ___ Gymnastics ___ Sideline Cheer ___ Soccer ___ Tennis ___ Track and Field ___ Wrestling
6	Have you ever been diagnosed with a concussion?	___ Yes ___ No ___ Don't know/unsure
7	Have you received education about sport-related concussion in the past 12 months?	___ Yes ___ No ___ Don't know/unsure
8	If you have received education about concussion, how was the information presented? Please select all that apply.	___ Consent form required for participation ___ Education from my coach ___ Education from my parents ___ Education from a medical provider (i.e. Athletic Trainer, Doctor) ___ Web based resource (i.e. Head-Up) ___ Magazines or other print material ___ Concussion fact sheet from the ___ Other:
9	On a scale of 1 – 10, how likely are you to report to your parent or coach that you think you might have a concussion? (1 – not likely, 10 – very likely)	1 2 3 4 5 6 7 8 9 10

SECTION 1 - Directions Please read the following statements and circle TRUE or FALSE for each question.

#	Statement	Response
1	There is a possible risk of death if a second concussion occurs before the first one has healed.	TRUE FALSE
2	Running everyday does little to improve cardiovascular health.	TRUE FALSE
3	People who had one concussions are more likely to have another concussion.	TRUE FALSE
4	Cleats help athlete's feet grip the playing surface.	TRUE FALSE
5	In order to be diagnosed with a concussion, you have to be knocked out.	TRUE FALSE
6	A concussion can only occur if there is a direct hit to the head.	TRUE FALSE
7	Being knocked unconscious always causes permanent damage to the brain.	TRUE FALSE
8	Symptoms of a concussion can last several weeks.	TRUE FALSE
9	Sometimes a second concussion can help a person remember thing that were forgotten after the first.	TRUE FALSE
10	Weightlifting helps to tone and/or build muscle.	TRUE FALSE
11	After a concussion occurs, brain imaging (CAT scan, MRI, X-ray etc.) typically shows visible physical damage (bruise, blood clot) to the brain.	TRUE FALSE
12	If you receive one concussion and you have never had a concussion before, you will become less intelligent.	TRUE FALSE
13	After 10 days, symptoms of a concussion are usually completely gone.	TRUE FALSE
14	After a concussion, people can forget who they are and not recognize others but be perfect in every other way.	TRUE FALSE
15	High-school freshmen and college freshmen tend to be the same age.	TRUE FALSE
16	Concussions can sometimes lead to emotional disruptions.	TRUE FALSE
17	An athlete who gets knocked out after getting a concussion is experiencing a coma.	TRUE FALSE
18	There is rarely a risk to long-term health and well-being from multiple concussions.	TRUE FALSE

SECTION 2 – Directions: Please read each of the following scenarios and circle TRUE or FALSE for each question that follows the scenarios

Scenario 1: **While playing in a game, player Q and player X collide with each other and each suffers a concussion. Player Q has never had a concussion in the past. Player X has had 4 concussions in the past.**		
1	It is likely that player Q's concussion will affect his long-term health and well-being.	TRUE FALSE
2	It is likely that player X's concussion will affect his long term-health and well-being.	TRUE FALSE

Scenario 2: **Player F suffered a concussion in a game. He continued to play in the game despite the fact that he continued to feel the effects of the concussion.**		
3	Even though player F is still experiencing the effects of the concussion, his performance will be the same as it would had he not suffered a concussion.	TRUE FALSE

SECTION 3 - Directions: For each question, circle the number that best describes how you feel about each statement. Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), Strongly Agree (5).

#	Statement	Response
1	I would continue playing a sport while also having a headache that results from a concussion.	1 2 3 4 5
2	I feel that coaches need to be extremely cautious when determining whether an athlete should return to play.	1 2 3 4 5
3	I feel that mouth guards protect teeth from being damaged or knocked out.	1 2 3 4 5
4	I feel that professional athletes are more skilled at their sport than high school athletes.	1 2 3 4 5
5	I feel that concussions are less important that other injuries.	1 2 3 4 5
6	I feel that an athlete has a responsibility to return to a game even if it means playing while still experiencing symptoms of a concussion.	1 2 3 4 5
7	I feel that an athlete who is "knocked unconscious" should be taken to the emergency room.	1 2 3 4 5
8	I feel that most high-school athletes will play professional sports in the future.	1 2 3 4 5

SECTION 4 – Directions: For each question, read the scenarios and circle the number that best describes your view. (For the questions that ask you what most athletes feel, base your answer on how you think MOST athletes would feel).

Scenario 1: **Player R suffers a concussion during a game. Coach A decides to keep player R out of the game. Player R's team loses the game. Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), Strongly Agree (5)**		
1	I feel that Coach A made the right decision to keep Player R out of the game.	1 2 3 4 5
2	Most athletes would feel that Coach A made the right decision to keep Player R out of the game.	1 2 3 4 5

Scenario 2: **Athlete M suffered a concussion during the first game of the season. Athlete O suffered a concussion of the same severity during the semifinal playoff game. Both athletes had persisting symptoms. Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), Strongly Agree (5)**		
3	I feel that Athlete M should have returned to play during the first game of the season.	1 2 3 4 5
4	Most athletes would feel that Athlete M should have returned to play during the first game of the season.	1 2 3 4 5
5	I feel that Athlete O should have returned to play during the semifinal playoff game.	1 2 3 4 5
6	Most athletes feel that Athlete O should have returned to play during the semifinal playoff game.	1 2 3 4 5

Scenario 3: **Athlete R suffered a concussion. Athlete R's team has an Athletic Trainer on staff. Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), Strongly Agree (5).**		
7	I feel that the Athletic Trainer rather than Athlete R should make the decision about Athlete R returning to play.	1 2 3 4 5
8	Most athletes would feel that the Athletic Trainer rather than Athlete R should make the decision about returning Athlete R to play.	1 2 3 4 5

Scenario 4: **Athlete H suffered a concussion and has a game in two hours. He is still experiencing symptoms of a concussion. However, athlete H knows that if he tells his coach about the symptoms, his coach will keep him out of the game. Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), Strongly Agree (5)**		
9	I feel that Athlete H should tell coach about the symptoms.	1 2 3 4 5
10	Most athletes would feel that Athlete H should tell coach about the symptoms.	1 2 3 4 5

<u>SECTION 5</u> – Directions: Think about someone who has had a concussion. Identify the following signs and symptoms that you believe someone may be likely to experience after the concussion. Please select all that you believe apply either alone or in combination.

___ Abnormal sense of smell	**___ Abnormal sense of taste**	**___ Amnesia (Memory Loss)**
___ Blurred vision	___ Black eye	___ Chest Pain
___ Confusion	___ Dizziness	___ Headache
___ Loss of Consciousness	___ Nausea	___ Nosebleed
___ Numbness/Tingling in Upper Extremity	___ Sharp burning pain in the neck	___ Sleep disturbances
___ Weakness of neck range of motion		

Appendix D

Scoring Key for RoCKAS-ST

Section															
1			2			3			4			5			
Item	**Correct Response**	**Index**	**Item**	**Correct Response**	**Index**	**Item**	**Safer Response**	**Index**	**Item**	**Safer Response**	**Index**	**Symtptom**	**Distractor/ Legitimate**	**Index**
1	TRUE	CKI	1	TRUE	CKI	1	SD/D	CAI	1	SA/A	CAI	Abnormal Smell	D	NI
2	FALSE	NI	2	FALSE	CKI	2	SA/A	CAI	2	SA/A	CAI	Blurred Vision	L	CKI
3	TRUE	CKI	3	TRUE	CKI	3	SA/A	NI	3	SD/D	CAI	Confusion	L	CKI
4	TRUE	NI				4	SA/A	NI	4	SD/D	CAI	Loss of Consciousness	L	CKI
5	FALSE	CKI				5	SD/D	CAI	5	SD/D	CAI	Numbness in UE	D	NI
6	FALSE	CKI				6	SD/D	CAI	6	SD/D	CAI	Abnormal Taste	D	NI
7	FALSE	CKI				7	SA/A	CAI	7	SA/A	CAI	Black Eye	D	NI
8	TRUE	CKI				8	SD/D	NI	8	SA/A	CAI	Dizziness	L	CKI
9	FALSE	CKI							9	SA/A	CAI	Nausea	L	CKI
10	TRUE	NI							10	SA/A	CAI	Sharp burning in neck	D	NI
11	FALSE	CKI										Weakness neck ROM	D	NI
12	FALSE	CKI										Amnesia	L	CKI
13	TRUE	CKI										Chest Pain	D	NI
14	FALSE	CKI										Headache	L	CKI
15	FALSE	NI										Nosebleed	D	NI
16	TRUE	CKI										Sleep Disturbances	L	CKI
17	TRUE	CKI												
18	FALSE	CKI												

CKI= Concussion Knowledge Index; CAI= Concussion Attitude Index; NI= No Index; SD/D= Strong Disagree/Disagree; SA/A= Strongly Agree/Agree; L= Legitimate Symptom; D= Distractor Symptom.

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